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SURGICAL ACCESS TO SEPARATE BRANCHES OF  
THE CAT VESTIBULAR NERVE

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## SURGICAL ACCESS TO SEPARATE BRANCHES OF THE CAT VESTIBULAR NERVE

L. A. Radkevich and G. S. Ayzikov\*

There are currently several published methods for access to separate branches of the cat vestibular nerve for purposes of electrical stimulation [3-5]. Their difference consists of the features of the surgical approach to the middle and inner ear of the animal, as well as the method of applying electrodes on that section of the vestibular nerve that is exposed to electrical stimulation. The outlet to the canalis and otolithic nerves at the level of receptor formations of the vestibule is fairly complicated. It requires definite experience in working with microobjects. /1748

The method that some authors [3,5] use in experimental practice is convenient for an outlet to the ampullae of the anterior and lateral canals and is less suitable for separating the nerve from the posterior semicircular canal and utricle. These authors use the ventrolateral access to the cat middle ear. The posterior ear approach used by other researchers [4,6] facilitates the separation of small branches from the posterior semicircular canal and the otolithic nerve, however, the outlet to the nerves of the anterior and lateral canals is complicated,

The posteroventral approach that we developed permits simultaneous surgical access to the ampullary and otolithic nerves. It is best to conduct surgery under general anesthesia.

The anesthetized animal is fastened into a stereotaxic instrument in a horizontal position with rigid fixing of the head and torso.

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Standard head-holders with ear clamps are not suitable for holding the head since they interfere with manipulation in the region of the middle and inner ears. We used screw clamps with pointed needles on the ends. They held the posterior section of the head in a horizontal position by fixing the skull in the mediolateral section of the parietal-occipital suture. The anterior part of the head was secured normally with zygomatic and palatal clamps. Rotation of the frame around the longitudinal body axis put the animal in a position that provided convenient access to the meatus acusticus externus from the side and somewhat from below. This corresponds to an 80° rotation of the cranium. The skin incision was made by circular movements at the base of the concha auriculæ. The muscles and underlying tissues were separated. The fibrocartilaginous section of the meatus acusticus externus was detached at the bone. A raspatory cleaned the root of the zygomatic process of the temporal bone and the bulla mastoidea. At the site of emergence from the temporal bone the facial nerve was cut. The middle ear was approached from the posteroventral side. For this purpose the thin osseous plates of the bulla mastoidea that comprise the external lower and posterior walls of it were cut. Then part of the inner wall of the bulla mastoidea that is adjacent from the bottom and the rear to the osseous meatus acusticus was carefully removed through the opened cavity. The middle ear was thus entered. After expanding the opening on the perimeter, the base of the cochlea and the round window were revealed. They became the landmarks for further surgical actions (see the figure, A). The roof of the bulla mastoidea was removed in pieces from the posterior and lower section of the osseous meatus. The tympanic membrane was removed and free access was obtained to the structural components of the middle ear. The osseous nerve and muscle-tendinous formations that are located in the middle ear (mm. tensor tympani, stapedius, n. facialis, malleus, incus) interfere with the manipulations to open up the vestibule. They need to be removed. The auditory ossicles were disarticulated in the joints. The malleus and incus were completely disjointed. The stapes was left intact. The mm tensor tympani and stapedius were cut and removed. Consequently, the medial and posterior walls of the cavum tympani became accessible. The promontorium was clearly isolated in this region. The lateral knee

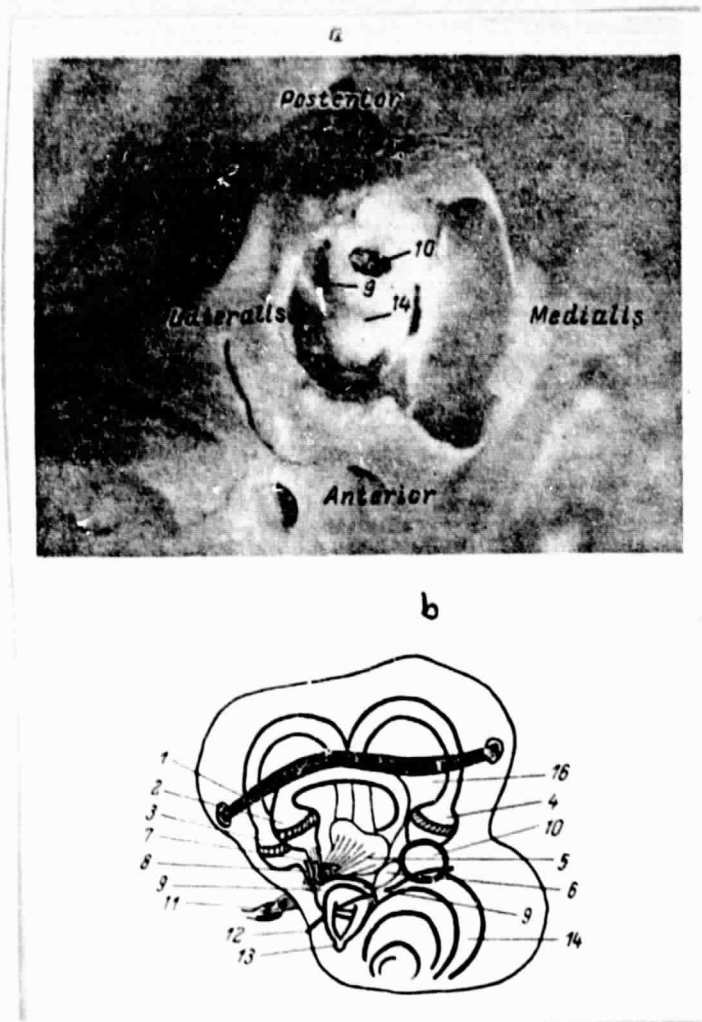
of the osseous canal of the facial nerve is located above the round window. It was opened up by accurate cutting of the osseous tissue until the facial nerve appeared. Then its anterior wall was removed along the course of the canal in a proximal direction up to the oval window (the canal passes somewhat higher than it, and 1-2 mm to the front and to the medial of the oval window). The separated part of the nerve was resected.

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Separation of the ampullary nerves of the anterior and horizontal semicircular canals. The ampullae of these canals are located in a row, while the nerves coming off of them initially travel separately, and then are joined into a common column at a certain angle. The utricular branch (see figure, B) approaches this column. The ampullary thickenings were visible on the posterior wall of the osseous canal of the facial nerve after the latter was removed. With illumination they were isolated as two dark spots at the supermedial edge of the oval window. For an outlet to the nerve branches in this region, thin openings were drilled, or a sharply pointed lance was used to carefully chip off the thin osseous plate that covered the nerve branches (the nerve of the anterior canal lies somewhat in a medial direction and towards the front). If one has experience there is no need to remove the stapes. This would inevitably lead to damage to the membrane that covers the oval window, and to discharge of the perilymph.

Separation of the utricular nerve. The utricular nerve was separated during removal of the stapes since the access to it lies through the oval window. After removing the stapes and enlarging the oval window by chipping off the medial edge, it was possible to enter the nerve of the utricle directly. With sufficient magnification the utricle could be seen well under directed illumination in the form of an elongated oval of grayish-rosy color. In the selected projection the utricle was visible from the macula. The nerve fibers exit from the entire visible surface of the utricle and are directed forward to the osseous septum, connecting with a short column of light gray color. Here the nerves join from the ampullae of the anterior and horizontal canals. To the lateral of the utricle, a sacculus is

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#### Osseous-Nerve Elements in Middle and Inner Cat Ear

a--middle ear of cat with open bulla (left labyrinth, view from posteroventral side); b--plan of receptor formations of vestibule in course of individual branches of vestibular nerve; 1--facial nerve; 2--ampulla of lateral canal; 3--ampulla of anterior canal; 4--ampulla of posterior canal; 5--utricle; 6--sacculus; 7--utricular nerve; 8--ampullary nerves of lateral and anterior canals; 9--oval window; 10--round window; 11--vestibular ganglion; 12--chorda tympani; 13--stapes; 14--cochlea.

is visible. It is turned with the otolithic part to the oval window. The sacculus looked significantly lighter due to the reflection of light from the surface of the otoliths. The saccular nerve was not visible since it immediately enters the osseous septum. On the free space it was covered by the mass of the sacculus itself. When the stapes was removed and the oval window was expanded the outflowing perilymph was not

removed since it promotes the preservation of the visible nerve. This method for separating the utriculur nerve was used by the authors in and experimental work and the results have been published [1,2].

Separation of the ampullary nerve of the posterior semicircular canal. The ampulla of the posterior semicircular canal approaches the basal loop of the cochlea that projects to the rear from the round window. Due to the fact that the preliminary access was made using the postero-ventral approach to the vestibule, there was no difficulty in exposing the ampulla and the nerve of its canal. On the side of the medial edge of the round window and somewhat to the rear the bone was chipped off (or drilled), as if enlarging the size of the window. The ampulla was then accessible for visual examination. The nerve lies somewhat below the ampulla and is directed forward and medially to the utriculo-ampullary branches. If it is necessary to make an isolated approach to the posterior ampullary nerve, then the posterior access to the vestibule is used. Here the posterior part of the bulla mastoidea is first cut, then part of its inner wall at the lower posterior edge of the osseous meatus acusticus for outlet to the promontorium and round window. After taking these points as the landmarks, the ampulla is separated from the nerve as already described, by chipping the bone to the rear from the round window.

In order to reveal the osseous septa, one can use small and medium-sized tooth drills. However, the drilling process produces chips that are hard to remove and forms heat during rotation of the drill in the bone. This requires thermometric control and constant washing of the surgical field with Ringer's solution to cool the tissues. In addition, the rotating drill, through careless movement, can cause damage to the structural elements of the vestibule. It is more convenient to use instruments from the standard eye and ear surgical sets, to sharpen several thin duplicates made of hardened steel, and to use small Luer's cutters.

During surgery, good hemostasis of the osseous hemorrhages is desirable. They are not abundant, however, they make surgery difficult. It is usually sufficient to apply a wax-paraffin paste with a thin



spatula, or paraffin paste that can be heated at the hemorrhage source by a thermocoagulation loop.

The electrodes to be inserted into the nerve fibers are made of thin platinum or tungsten wire with electrolytic sharpening of the end. They are covered with electrical-insulating lacquer. It is best to use a micromanipulator to insert the electrodes that has sufficient mobility to direct it into the surgical field. The electrodes are fixed by rapidly-hardening cement.

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